2.7 CCLME – Salmon – Ocean data and models for the central CC

Fisheries Ecology Division
NOAA Fisheries
Santa Cruz, CA 95060
(v) 831 420-3969
brian.wells@noaa.gov

Wells, B.K., J.A Santora, I.D. Schroeder, W.J. Sydeman, N. Mantua, D.D. Huff, J.C. Field. *In revision*. A marine ecosystem perspective on Chinook salmon recruitment variability. *Marine Ecology Progress Series*.

Addressing overarching questions:
Q4, What is the status of oceanographic, habitat, climate and ecological data required to fulfill ecosystem-related science needs? Has the Center developed strategies to obtain and manage such data?

Q5, Is the Center appropriately analyzing and modeling ecosystem-level processes? Are cumulative and integrative ecosystem-level analyses being conducted? If not, is there a plan in place to initiate or contribute to the science needed to address cumulative impacts?

April 19, 2016

History of the Salmon Ocean Ecology Program

Primary questions past and present

- Population-specific estimation of vital rates informing tactical management
- Ecosystem-relevant studies informing strategic management

Resources past and present

- Staffing
- Surveys
- Funding sources

Take home points

- Integration of multiple survey platforms and numerical ecosystem models can be used to examine biophysical drivers of salmon dynamics in the ocean.

- ***We can evaluate the likely outcomes of freshwater management strategies by relating the ocean conditions to salmon dynamics*** (e.g., size, timing and abundance of salmon emigrating to the the ocean).

2.7 CCLME – Salmon – Ocean data and models for the central CC

Basin-scale influences and preconditioning of central California shelf

Salmon survival

Communicating the results

Simulation (Individual Based Model)

2.7 CCLME – Salmon – Ocean data and models for the central CC

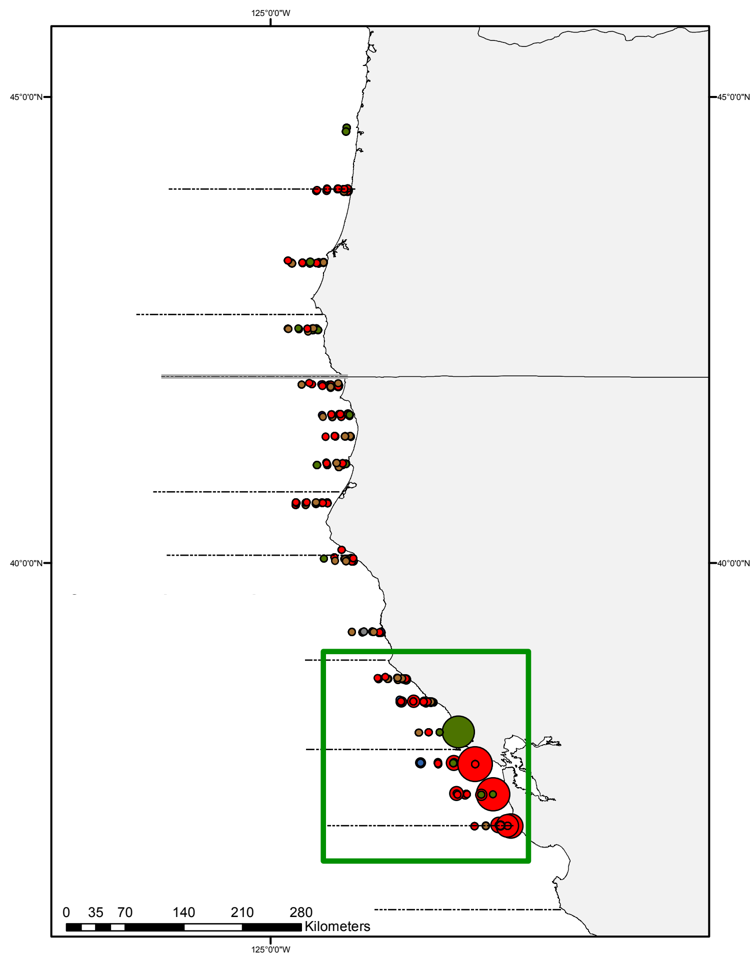
Basin-scale influences and preconditioning of central California shelf

Salmon survival

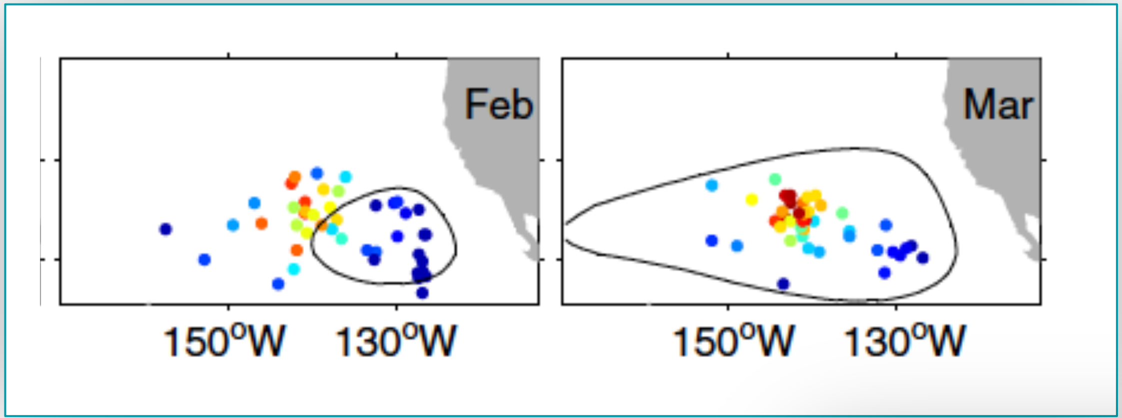
Communicating the results

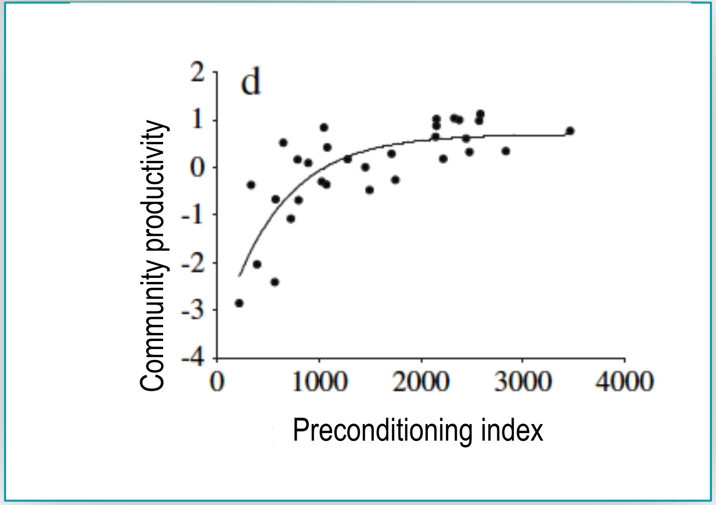
Simulation (Individual Based Model)

Central California is a hotspot for forage



North Pacific High characteristics in the winter relate to spring production on shelf

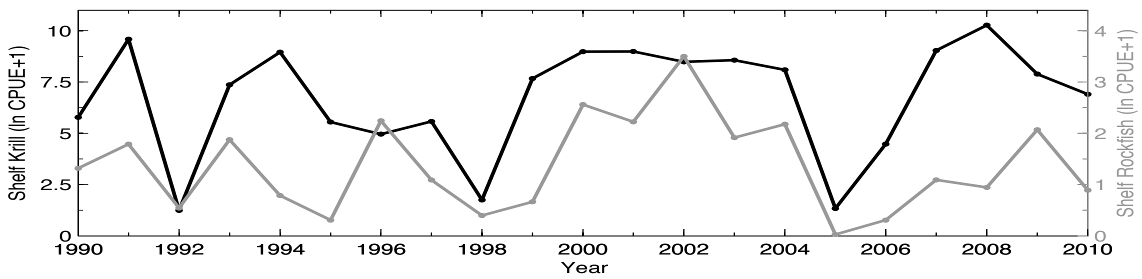




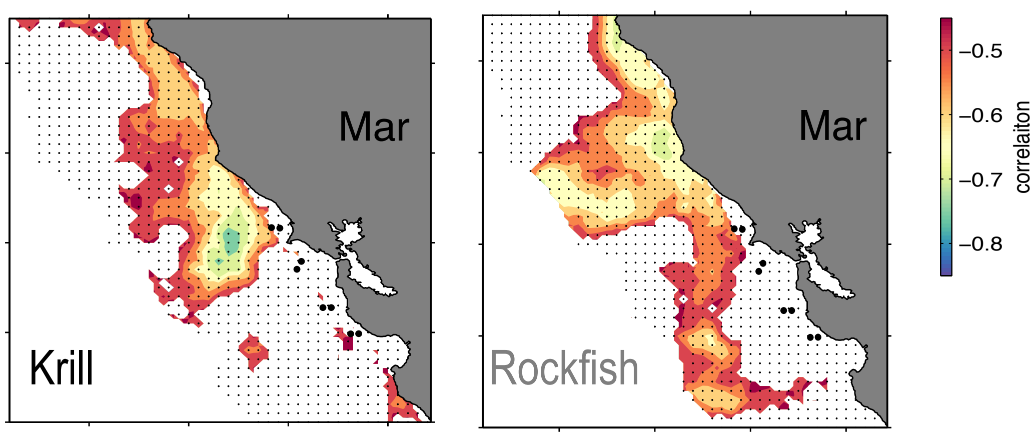
Schroeder, I.D., E. Hazen, B.A. Black, S.J. Bograd, W.J. Sydeman, J. Santora, and B.K. Wells. 2013. The North Pacific High and wintertime pre-conditioning of California Current productivity. *Geophysical Research Letters.* 40:541-546

Prey abundance on the shelf in spring relates to winter transport and nutrient introduction

Abundances on shelf in May-June



Correlation of 26.0 isopycnal depths in *March* to prey abundance in spring



Schroeder, I.D., J.A. Santora, A.M. Moore, C.A. Edwards, J. Fiechter, E.L. Hazen, S.J. Bograd, J.C. Field, and B.K. Wells 2014. Application of a data-assimilative regional ocean modeling system for assessing California Current System ocean conditions, krill, and juvenile rockfish interannual variability. *Geophysical Research Letters*.

2.7 CCLME – Salmon – Ocean data and models for the central CC

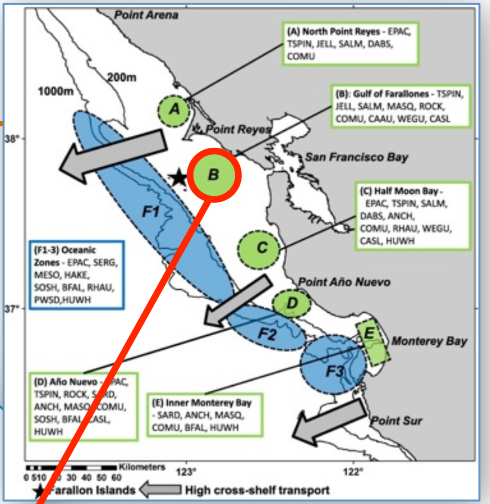
Basin-scale influences and preconditioning of central California shelf

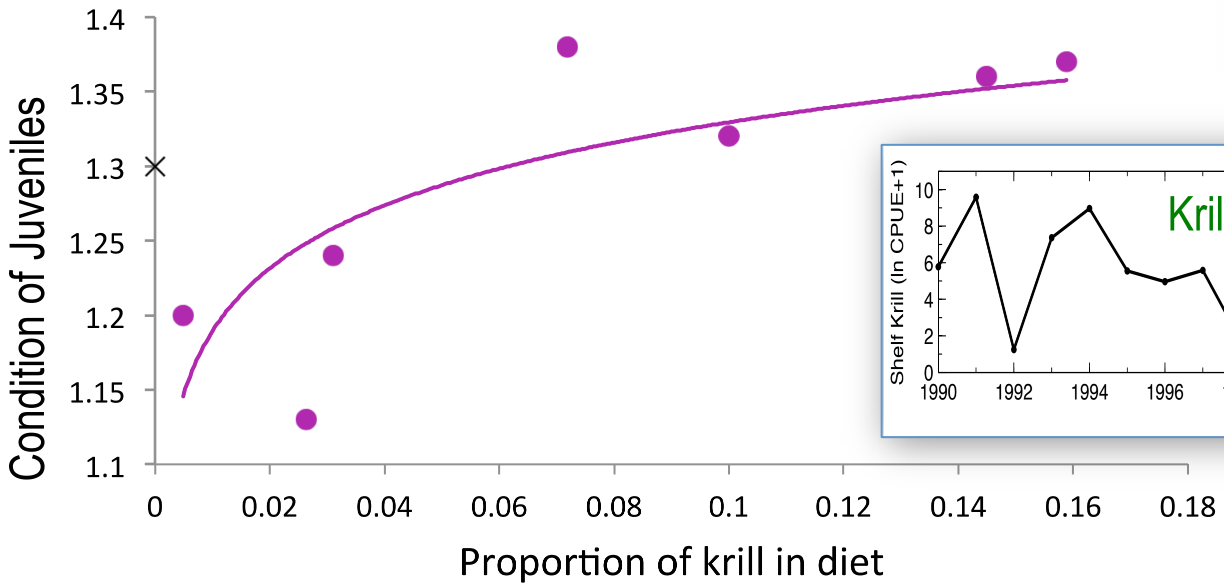
Salmon survival

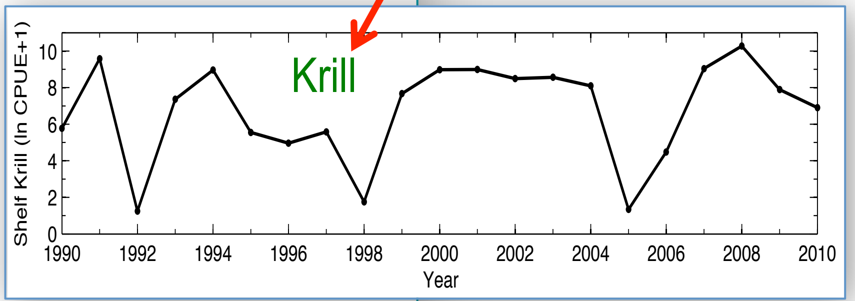
Communicating the results

Simulation (Individual Based Model)

More prey = fatter fish

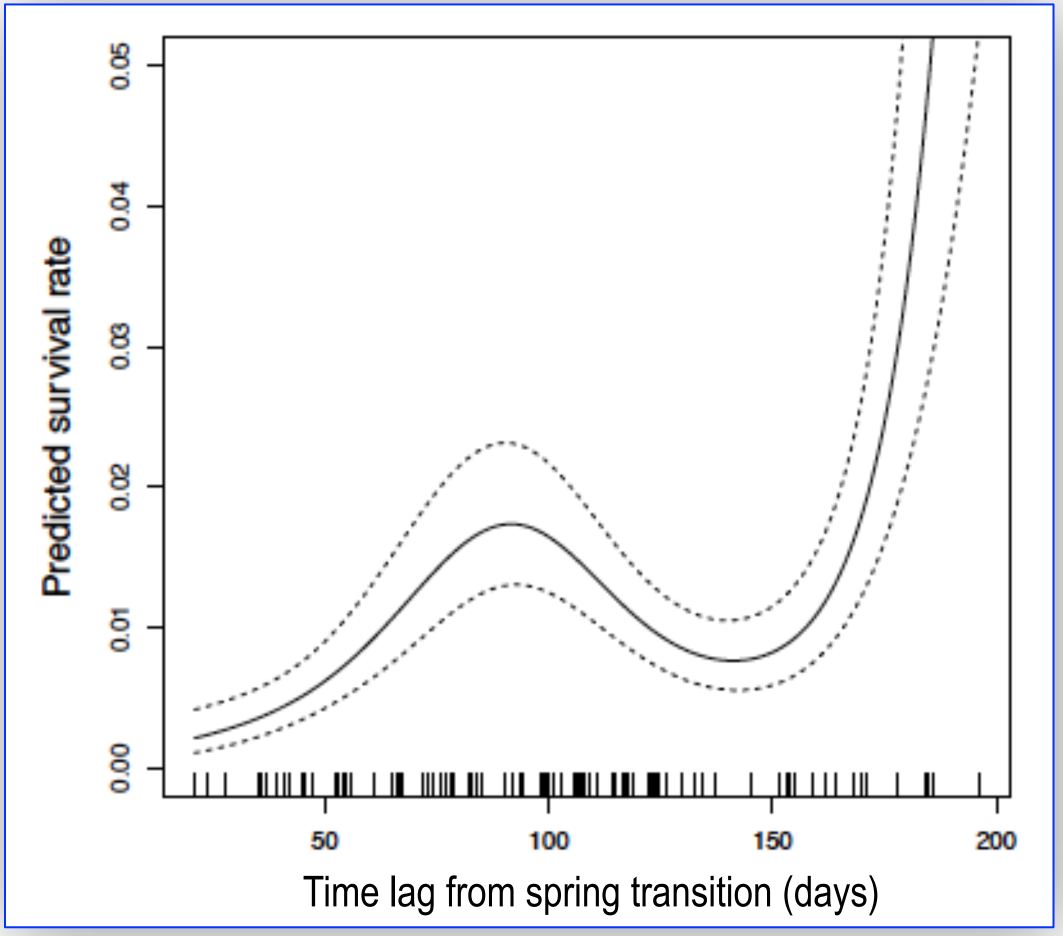






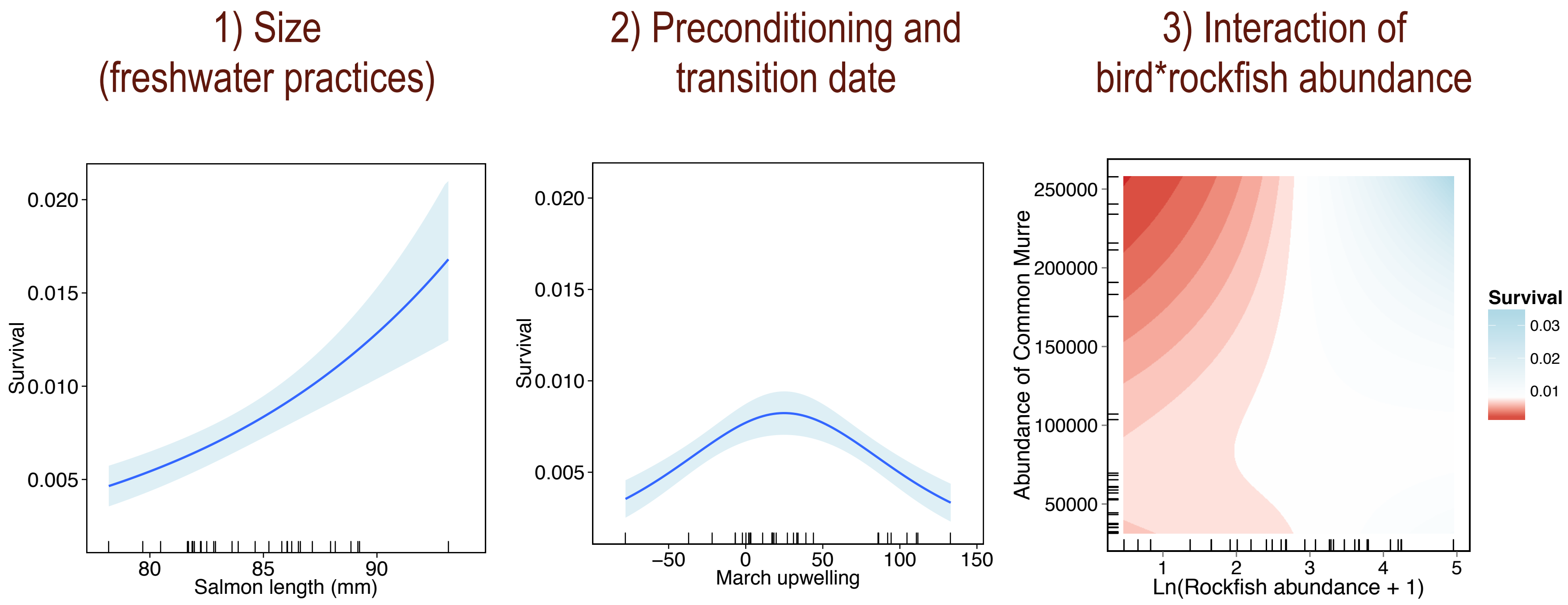
Wells, B.K., J.A. Santora, J.C. Field, R.B. MacFarlane, B.B. Marinovic, and W.J. Sydeman. 2012. Population dynamics of Chinook salmon (*Oncorhynchus tshawytscha*) relative to prey availability in the central California coastal region. *Marine Ecology Progress Series*. 457:125-137

Salmon released ~100 days after initiation of upwelling have greater probability of survival



Satterthwaite, W.H., S. M. Carlson, S. Vincenzi, S.D. Allen-Moran, S.J. Bograd, and B.K. Wells. 2014. Match-mismatch dynamics and the relationship between ocean-entry timing and relative ocean recovery rates of Central Valley fall run Chinook salmon. *Marine Ecology Progress Series*. 511:237-248.

A unifying model demonstrates that 1) salmon size, 2) early upwelling conditions, and 3) abundance of prey and predators relate to salmon survival



2.7 CCLME – Salmon – Ocean data and models for the central CC

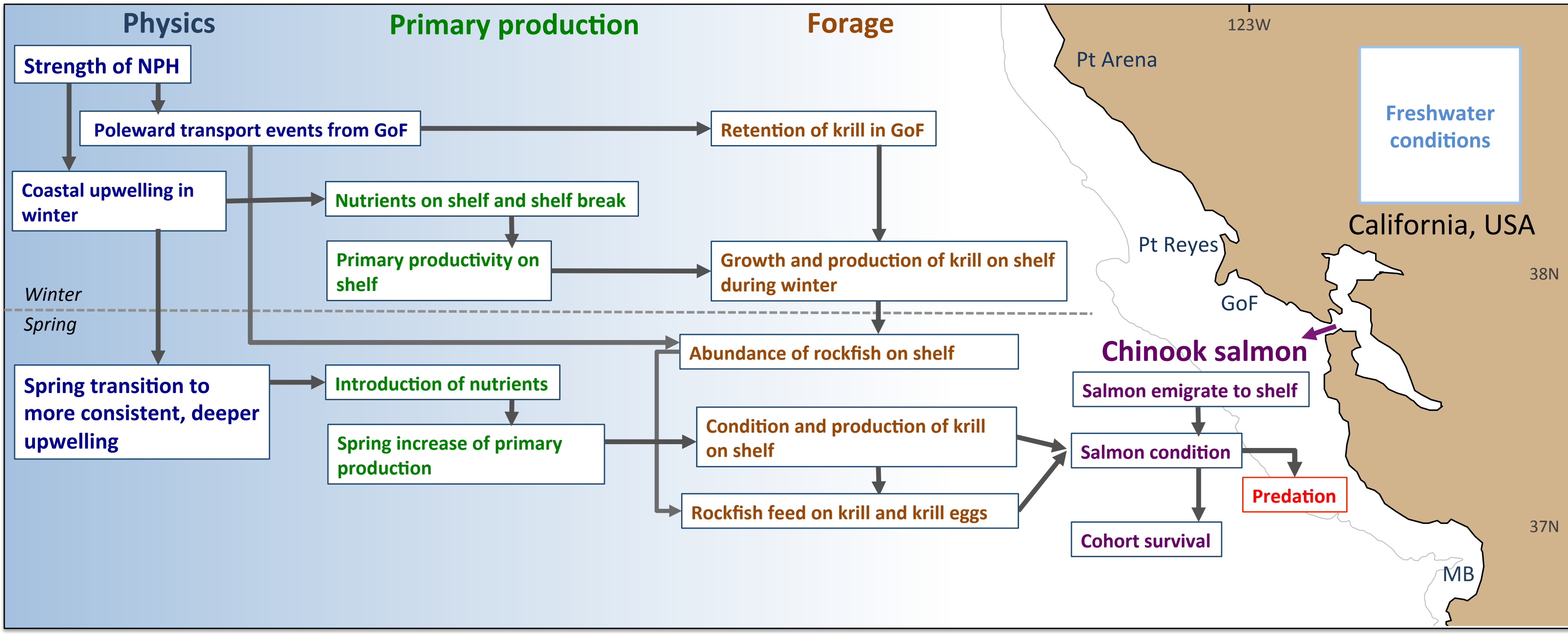
Basin-scale influences and preconditioning of central California shelf

Salmon survival

Communicating the results

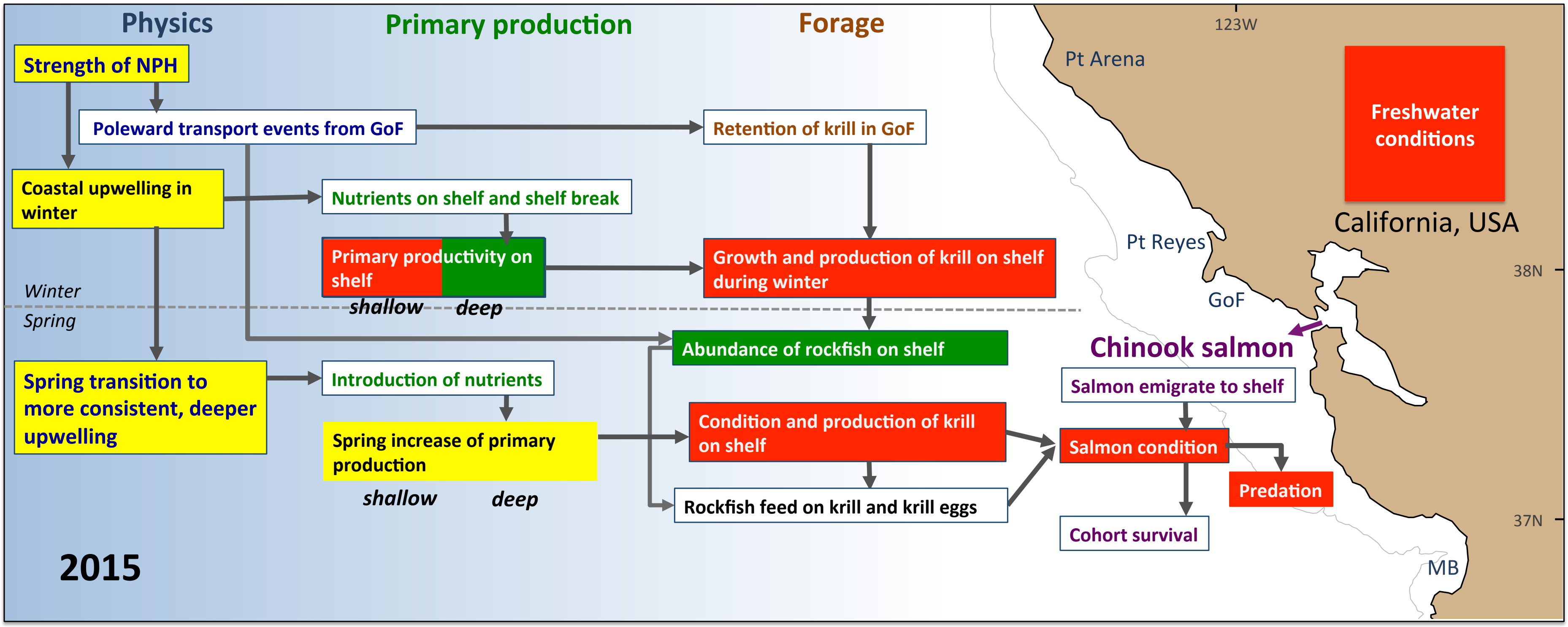
Simulation (Individual Based Model)

Conceptual models can frame these findings



Wells, B.K., J.A Santora, I.D. Schroeder, W.J. Sydeman, N. Mantua, D.D. Huff, J.C. Field. *In revision*. A marine ecosystem perspective on Chinook salmon recruitment variability. *Marine Ecology Progress Series*.

Conceptual models can be used to see the overall state of the ecosystem



2.7 CCLME – Salmon – Ocean data and models for the central CC

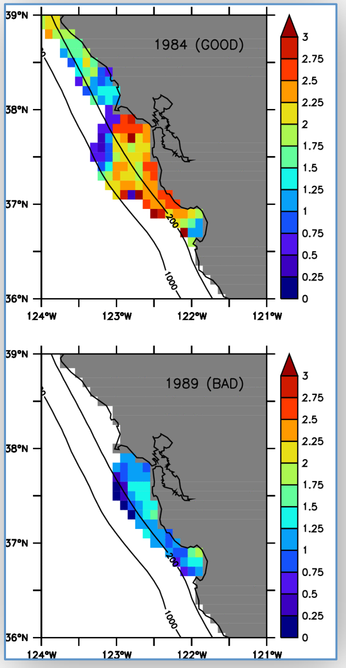
Basin-scale influences and preconditioning of central California shelf

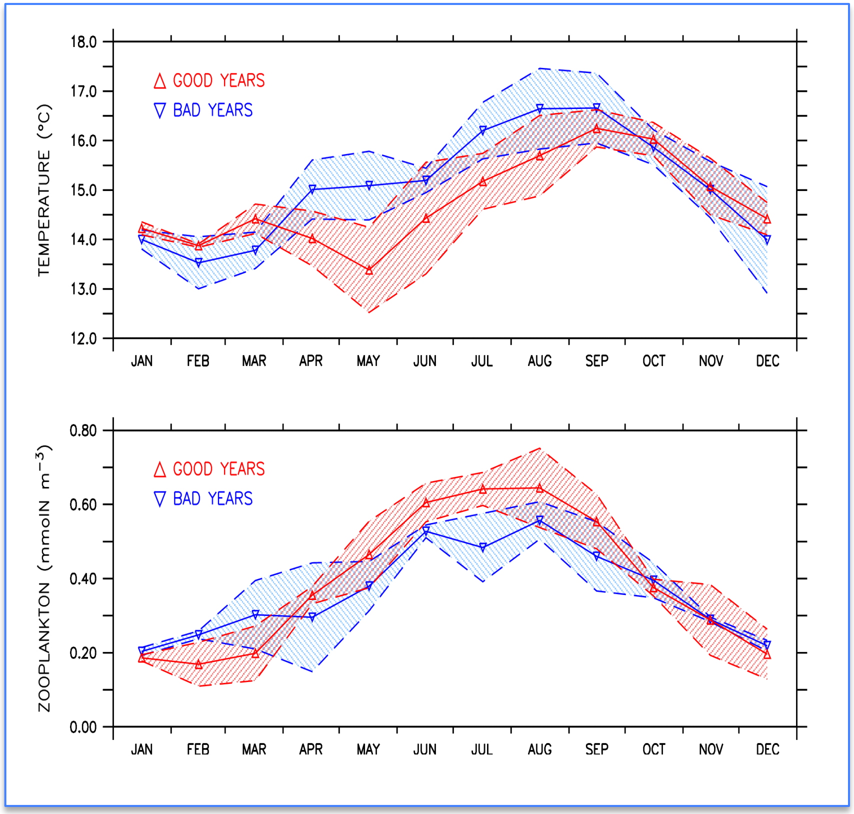
Salmon survival

Communicating the results

Simulation (Individual Based Model)

Individual Based Models demonstrates validity of our findings and provides a tool to close the life-cycle loop





Fiechter, J., D.D. Huff, B.T. Martin, D. Jackson, C.A. Edwards, K.A. Rose, E.N. Curchitser, K.S. Hedstrom, S.T. Lindley, and B.K. Wells. 2015. Environmental conditions impacting juvenile Chinook salmon growth off central California: an ecosystem model analysis. *Geophysical Research Letters*. 42:2910-2917

2.7 CCLME – Salmon – Ocean data and models for the central CC

Strengths

- Collaboration across disciplines
- Ecosystem analytical approaches
- Developing biophysical models

Challenges

- Limited salmon survey effort
- Need to focus more on hypothesis-driven research
- Connecting ocean components to estuarine and freshwater life cycle models

Strategies

- Refitting current surveys to include salmon collections
- Working actively with modelers for full life-cycle simulations